

# LUBRICATION

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We invite correspondence from all those interested.

Those who fail to receive LUBRICATION promptly, will please notify us at once and will confer a favor by promptly reporting change of address.

## "ABOUT TEXACO CRATER COMPOUND"

We have sent a copy of the 32-page book with the above title to all subscribers of "Lubrication." We trust the matter contained therein will be of interest and value to all our readers.

If after reading this booklet, there are some points which require additional explanation, do not hesitate to call on us. We earnestly solicit such requests and are greatly pleased to answer questions regarding CRATER or any other lubricant to the best of our knowledge and experience.

If you haven't received the book or want additional copies, let us know.

## IT IS NOT THE PRICE OF THE OIL THAT COUNTS

A large concern in the Middle West operating a considerable number of heavy and light machines, has been accustomed to buy the oil for its operations mainly on price.

One of the units, a Buckeye Compound Engine, 18 $\frac{3}{4}$ "x38"x30" slide cut-off piston valves, was giving trouble from time to time

under the old oils. After every shut-down, difficulty was experienced in re-starting the engine.

The cylinder oil being used was costing in bulk 27 cents per gallon and the quantity was as follows:

	L.P.	H.P.
Drops per Hour.....	45	26
Cubic Centimeters		
per Hour.....	300	171.6

Our engineers arranged to use an oil which would better meet the conditions of moisture, etc., which was one of our regular brands at a price of 45 $\frac{1}{2}$  cents per gallon bulk.

The consumption of this oil was:

	L.P.	H.P.
Drops per Hour.....	15	5.5
Cubic Centimeters		
per Hour.....	99	36.3

giving an average saving in consumption of 73%.

One gallon of the former oil was used while only .27 of a gallon of the new oil was required for the same period, which would make the following gallon price comparison:

The old oil at 27c	
per gal. cost .....	.27
The new oil at 45 $\frac{1}{2}$ c	
per gal. cost .....	.1471
A saving of ...	.1229 per gal.

The right oil in the right places is always economical from the operating standpoint and Texaco Oils are recommended only for their proper work.

## OIL GROOVES IN BEARINGS

By C. N. SCOTT, Consulting Engineer

Many theorists on lubrication maintain that oil grooves in a bearing are detrimental, in that they (1) reduce the bearing surface, and (2) offer a means of escape of the oil from between the two rubbing surfaces of the journal. Theoretically, these men are right, as far as they go, but they lose sight of the fact that means have to be provided (1) for getting the oil to and distributing it over all portions of the bearing surfaces, and (2) for retaining the oil in the journal; and it is these functions which oil grooves perform so successfully which make them indispensable.

We have seen many instances where the theory that oil grooves were unnecessary and detrimental was followed, and which resulted in continual trouble from heating of the bearings until the operating engineer took it upon himself to provide oil grooves, after which no heating or kindred troubles were experienced.

There are many different arrangements of oil grooves in use; some of them are planned with due regard for what they are intended to accomplish; others are planned without any conception of what oil grooves are intended to do or how they are to do it; and others are not planned at all, but are as aimless as, and often resemble, worm tracks in soft mud.

Most manufacturers of engines and machinery design their product, giving little or no consideration to the matter of detail lubrication, leaving the placing of oil holes and the designing and locating of oil grooves entirely to the "judgment" of the shop foremen or of the

erector who sets up the engine or machine in the shop, or of the individual fitters who assemble the different parts. In other words, oil holes and oil grooves are seldom shown on the drawings, but their design is generally left to men who, while they are good shop mechanics, yet know little or nothing of the operation and lubrication of such machinery. Is it any wonder, then, that bearing troubles are experienced and that operating engineers in many instances find it necessary to use much oil with less efficiency when, if oil grooves had been correctly designed, a proper amount of suitable oil would work better and at much less cost.

The functions which oil grooves are intended to perform are:

- (a) To provide a receptacle for receiving the oil into the bearing.
- (b) To distribute the oil lengthwise of the bearing, so that the moving surface passing the grooves or chamfers is bathed in and coated with oil.
- (c) To distribute oil from the grooves and chamfers over the bearing surfaces.
- (d) To catch oil which has squeezed over towards the ends of the bearing and thus prevent it from working out of the bearing entirely; and
- (e) To return such oil to the center of the bearing, where the cycle of distributing, catching and returning it again to the center of the bearing is again started and repeated over and over.

In order to more fully explain these functions, we would refer you

to sketch No. 1, which shows the grooving of the crank-pin boxes of a connecting rod of a large horizontal engine. Oil enters at A; drops or runs on to the crank-pin, and accumulates at B; spreads in both directions along the chamfered edge B (which acts as a primary groove), and coats the surface of the pin, as well as surface C, with oil. Upon reaching the secondary grooves D, D, the oil leaves the chamfered edge and follows the secondary grooves back to the center of the bearing at E, being distributed from the secondary grooves over the surfaces F, F, F. From the surfaces F, F, F the oil works into the primary groove G, in which it is again spread in both directions to the secondary grooves H, H, being again returned in these to the center of the bearing, as before, and distributed over the surfaces I, I, I. These functions are repeated over and over.

In grooving bearings, it is of the greatest importance that the following general instructions be observed:

1—Do not groove both the male and female surfaces of a bearing; grooving one surface is right, grooving both surfaces is wrong. The female or enveloping surface is the one which should be grooved; for example:

- (a) The bearing surfaces of the connecting rod boxes are grooved, and not the surface of the crank-pin and cross-head pin.
- (b) The bearing surfaces of the crank-shaft bearing shells or boxes are grooved, and not the bearing surfaces of the crank-shaft.
- (c) The bearing surface of the eccentric strap is grooved, and not the bearing surface of the eccentric.

- (d) The bearing surface of a pillow-block is grooved, and not the surface of the shafting.

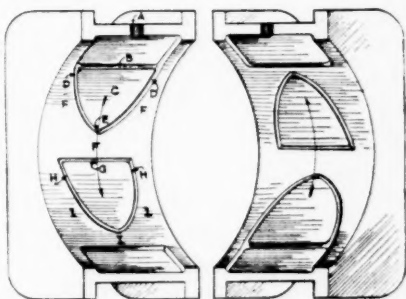


FIG. 1.

Crank-Pin Boxes of a Connecting Rod,  
Showing Oil Grooves

- (e) The bearing surface of the hole in a connection head is grooved, and not the surface of the pin.

There are a few exceptions to this rule, among them being:

- (1) The bearing surfaces of the shoes of a cross-head, which are grooved, and not the bearing surfaces of the bored guides.
- (2) The bearing surface of shafting or sleeves which work in long, solid bearings and which are grooved on account of the bearing being too small in diameter and too long to permit of internal grooving.

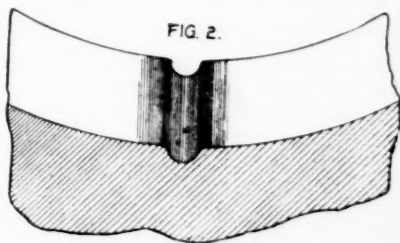


FIG. 2.

Section Thru Part of Bearing, Showing  
Rounding of Corners of Oil Groove

2—Make the width and depth of the grooves good and liberal. It is customary to err in the direction of making them too narrow and too shallow, with the result that they clog up too readily. If a bearing which is equipped with shallow, narrow grooves heats slightly at any time, the grooves become plugged, lubrication ceases, and it is then necessary to shut the engine or machine down and dismantle the bearing in order that the deposit can be removed from the grooves.

It is difficult to fix any general rule for the dimensions of oil grooves, but the following one gives results which agree closely with the best practice:

#### **For Width of Groove:**

Multiply the diameter of shaft or pin in nearest even inches by .01 and add  $1/10''$ .

#### **For Depth of Groove:**

Take half of width.

#### **Examples:**

Grooves for a 30" crank-shaft bearing would be  $(30'' \times .01) + .1'' = 4/10''$  wide and  $2/10''$  deep, or say  $3/8''$  wide by  $3/16''$  deep.

Grooves for a 12" crank-pin box would be  $(12'' \times .01) + .1'' = 22/100''$  wide and  $11/100''$  deep, or, say  $1/4''$  wide and  $1/8''$  deep.

Grooves for a pin bearing 1-3/4" diameter would be  $(2'' \times .01) + .1'' = 12/100''$  wide and  $6/100''$  deep, or, say  $18''$  wide and  $1-16''$  deep.

Well designed bearings will have sufficient thickness of babbitt lining or bushing to safely accommodate the above depth of groove.

3—Round all corners of grooves well, as shown in section in Figure 2. This is important, as it ensures the flowing or "wedging" of oil from

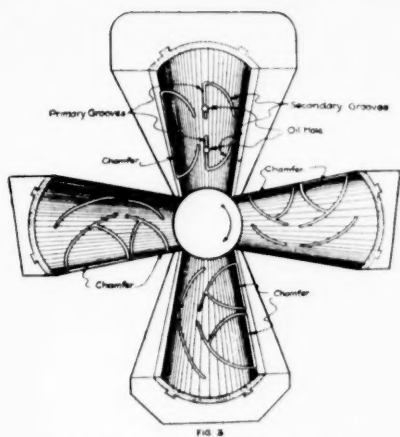
the grooves into the space between the rubbing surfaces. An oil groove having sharp, square edges will scrape oil from the ungrooved surface of the journal instead of allowing a fine film of oil to squeeze from the oil groove into the space between the rubbing surfaces. This rounding of the edges of oil grooves is one of the most important factors in securing successful lubrication of a bearing and is the one which in so many instances is neglected entirely. If an engineer desired to provide a number of sharp scrapers to remove the oil from the ungrooved surface of the journal, he could not do it more effectively than by the use of sharp-edged oil grooves.

4—Be careful to arrange the oil grooves with particular reference to the direction of motion of the ungrooved surface on the grooved one. This is of the greatest importance, because it is this movement of one surface on the other which effects the movement of the oil in the bearing, and if a bearing is grooved for the wrong direction of motion the grooves will work the oil out of the bearing instead of towards the center of it. Gravity has little or no effect on the movement of oil in a journal.

5—Do not extend the grooves too close to the edges of the bearing surfaces, as this would allow the oil to escape from the journal. As a general proposition, keep grooves away from edges of bearing surfaces from  $3/4''$  to  $1-1/2''$ , depending on the size of the journal.

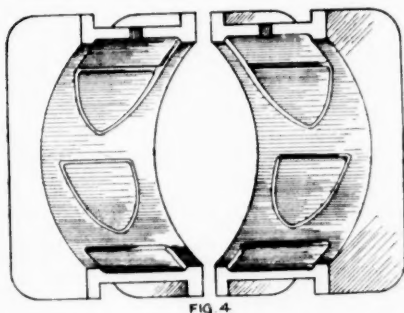
6—Grooves and chamfers should be smooth and regular.

Figure 3 shows the oil grooving in the main crank-shaft bearing of a horizontal engine. This bearing is of the 4-part type, consisting of two side shells, one top shell and one



Crank-Shaft Bearing for Horizontal Engine Showing Oil Grooves

bottom shell. This type of bearing is a difficult one to lubricate successfully and economically unless it is properly grooved. A study of these grooves will show how they effect the distributing, catching and returning of the oil to the center of the bearing.



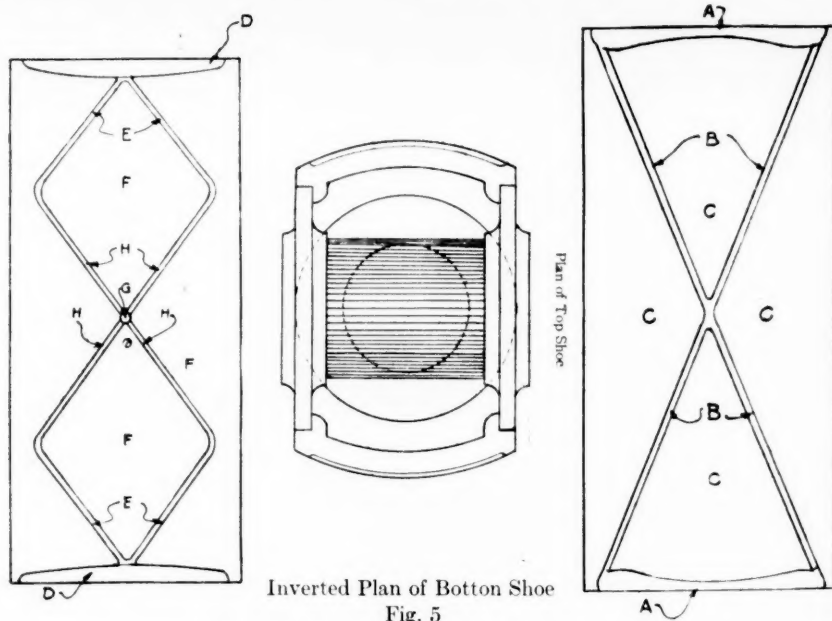
Cross-Head Pin Boxes of a Connecting Rod, Showing Oil Grooves

Figure 4 shows the oil grooving in the cross-head pin boxes of a connecting rod of a horizontal engine. It will be noted that while the grooves are similar in arrangement to those in the crank-pin boxes shown in Figure 1, they differ in this respect, that both halves of

the box are grooved for surface wiping movement from the top down; this for the reason that the movement of the connecting rod boxes on the cross-head pin is an oscillating one.

Figure 5 shows the oil grooving of the top and bottom shoes (or gibs) of a main cross-head of a horizontal engine which has the regular bored guides. There is no part of an engine more difficult to lubricate satisfactorily and economically than these bored guides, because the tendency is for the oil, in the case of the upper guide, to work down towards the lower edges, leaving the top or central portion of the guide dry; and in the case of the lower guide the tendency is for the oil to remain in the central portion of the guide, leaving the upper edges or sides dry. The effect of well designed oil grooves on the distribution of oil over surfaces can be noted better on such guides than on any other part of an engine, and a study of the grooves shown in Figure 5 and a close observation of the performance of their functions in actual operation will reveal more of what oil grooves do and how they do it than anything else we can suggest.

The plan view shows the bearing surface of the top shoe. Since the tendency in the case of the upper guide is for the oil to work down towards one or both of the lower edges of the guide, or be thrown off from the guide entirely, the chamfers A, A are made almost the entire width of the shoe at both ends of same and the grooves B, B, start from the ends of the chamfer. In operation, as the shoe advances the oil works along the chamfered edge until it reaches the grooves B, B which it enters, and following



Showing Oil Grooves in Main Cross-Head

them is worked back up to the center or highest portion of the guide, also distributing the oil from the grooves over the surfaces C, C, while in motion.

The inverted plan shows the bottom shoe. In the case of the lower guide the tendency is for the oil to work down towards and lie in the center or lower portion of the guide and be thrown out at the ends of the guide. The chamfers D, D are therefore made to converge towards the center of the shoe, from which point the grooves E, E start and extend to points near the sides. In operation, as the shoe advances the oil works along the chamfer to the center or lowest point, where it enters the grooves E, E, and following them is worked back up to points near both sides of the guide, also being distributed from the grooves over the surfaces F, F.

In properly designed cross-heads an oil pocket is formed on the upper side of the bottom shoe to catch the oil which drips from the cross-head pin boxes, and an oil hole G is drilled through the shoe so that oil caught in the oil pocket is fed to the guide through the shoe. This oil hole G communicates with the grooves H, H, which work the oil up to the sides of the lower guide in the same manner that grooves E, E do.

In some engines the "pumping" effect of these grooves in the bottom shoe is so extreme as to result in displacing the oil from the center of the guide too rapidly. In such cases (and it is advisable to do so in every case where feasible) oil troughs or grooves should be formed along the sides of the guide to catch the oil which spills over from the guide, and by means of holes or grooves return it again to the guide.

## FIRST GOVERNMENT-BUILT DIESEL ENGINES

*(Reprinted from "Power")*

One of the two Diesel engines built at the New York Navy Yard for the fuel ship "Maumee" has just undergone a series of tests on the erecting floor preparatory to its shipment to San Francisco, where the ship itself is being built. The tests included runs with different grades of oil, but the results will not be available until the official reports have been made.

The "Maumee" is one of two twin-screw fuel ships authorized by Congress in 1912, the sister ship, the "Kanawha," being fitted with two triple-expansion steam engines of 2,600 i. h. p. each and oil-fired boilers. Since the vessels are identical except the propelling machinery and will be employed in the same kind of service, excellent opportunity will be afforded to compare performances. The propelling machinery of the Diesel-engined ship will occupy approximately the same space as the boilers and steam engines of the other, and the machinery weight will be slightly more. When the weight of fuel for the same cruising radius is included, however, the advantage will be with the Diesel engine.

When it was decided to install Diesel engines in the "Maumee," the Bureau of Steam Engineering, in order to gain a maximum of Diesel-engine experience in a minimum time, set about to obtain the manufacturing rights and a set of working plans from some company already engaged in that line of work, and to build the engines in one of the navy yards. The Navy Department therefore obtained bids from various companies at home and abroad and finally contracted

with the Electric Boat Co., of Groton, Conn., American licensees of the Maschinenfabrik Augsburg-Nuernberg, of Germany. The Electric Boat Co., through a subsidiary company—the New London Ship and Engine Co., manufactures two-stroke-cycle single-acting Diesel engines of this type for submarines.

The contractor obtained the original designs and drawings from the home company, translated all figures from the metric to the English system, and supplied the Government with a set of retraced drawings in which only slight departures were made from the original design. These drawings were then checked with the originals at the navy yard. It would perhaps have been cheaper to build the engines from the original metric dimensions, as the translated drawings contained decimals to the thousandths of an inch and made the shop work rather slow and tedious. With the exception of some of the heavy forgings all parts were made in the navy yard.

The engines are of the single-acting two-stroke-cycle type, each rated at 2,500 hp. in six cylinders when turning over at 130 r. p. m. They are of A-frame construction with double crosshead guides, and the cylinder covers contain the fuel valves, scavenging air valves and starting air valves, the exhaust being through ports in the cylinder walls. Each cylinder has a separate fuel pump, and there is one fuel-supply pump for delivering the oil from the ship's bunker tank to the engine-supply tanks.

Besides the fuel pumps, the following auxiliaries are driven

from the main engine: Three high-pressure air compressors for fuel injection and for starting air; three scavenger compressors for cylinder scavenging; two salt-water pumps for jacket cooling; one fresh-water pump for piston cooling; one lubricating-oil pump for the thrust block, main bearings, crankpins and crossheads; two general-service water pumps; and twelve mechanical lubricators for the cylinders and minor lubrication. A governor and a revolution counter are also fitted. Steam for

heating, deck engines, etc., will be furnished by two small oil-fired boilers.

TEXACO URSA OIL was the lubricant selected for the complete shop trials of both engines, URSA being used for the power cylinders, air compressors, and as a general lubricant for all other parts.

This oil performed its work with its usual efficiency, further establishing the position of TEXACO URSA OIL as the Diesel Engine Oil par excellence.

### "CONSIDER THE DROP"

From the record of a test made upon the engines of an Ice plant in Georgia, we have taken the following item which points directly to the advantage secured from the use of the right oil.

The main units of this plant are:

1 Skinner Automatic 10"x16"—225 R. P. M.

1 York Ice Machine, driven by a Corliss Type Engine—20"x24"—74 R. P. M.—100 tons capacity.

On both these units the cylinder oil in use before Texaco Cylinder Oil was installed required a constant average feed of 12 *drops per minute*, with the addition of an extra supply through the auxiliary pumps several times per watch.

On the first day of the use of

Texaco 650 T Cylinder Oil on both these engines, the feed to the cylinder was cut to 4 *drops* per minute and since that time the feed has been maintained at an average of 3 *drops* per minute without any use of the auxiliary pump or temporary increase of supply. The customer reports that the lubrication of the units is thoroughly satisfactory.

An excessive use of cylinder oil in the cylinders of engines in an ice plant is rather dangerous, as the oil will get back through the condensed steam to the water from which the ice is made—any oil for this class of work must be a most excellent lubricant to allow of the minimum feed.